

REMARKS

Claims 1-33 were pending and subject to a restriction and/or election requirement.

Claims 19-22 have been elected with traverse, and the provisional election set forth in paragraph 6 of the Action is hereby affirmed.

Claims 1-18 and 23-33 have been withdrawn from prosecution. Claim 34 has been added.

Claims 19 and 20 have been amended to recite that the epoxy-extended polyacrylate has a  $\beta$ -hydroxyester linkage. Support for this amendment is replete throughout the specification, such as at page 5, paragraph [0021] and Example 1. These claims have also been amended to recite a carboxylic acid as the functionality of the polyacrylate from which the epoxy-extended polyacrylate has been prepared. Support for this amendment is replete throughout the specification as well. These claims have also been amended to delete the polydispersity recitation, as the Examiner seemingly gave no patentable weight to that recitation.

Claims 19-22 remain in prosecution and Claim 34 is presented herein, with Claims 19 and 20 being independent.

Applicants turn to the substance of the Action.

**Sections 102(b) and 103(a) Rejections**

Claims 19-22 stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by or in the alternative under 35 U.S.C. § 103(a) as allegedly being obvious over the article by Wang, "Photosynthesis and Application of Polyfunctional Poly(n-Butyl Acrylate) Elastomers for Use in Epoxy Resin Toughening", J. Appl. Polym. Sci., 44, 789-797, (1992) or U.S. Patent No. 4,460,746 (Fock) for the reasons given at pages 7-8 of the Action.

Applicants traverse the Sections 102(b) and 103(a) rejections.

As the Examiner is aware, the present invention as defined by Claim 19 is directed to and claims a method to improve the fracture toughness of an epoxy-based adhesive composition.

The method includes the steps of adding to the adhesive composition an effective amount of a toughening agent comprising an epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage. The polyacrylate from which the epoxy-extended polyacrylate is derived has a

number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid.

And as defined by Claim 20 the invention is directed to and claims an adhesive formulation comprising a curable epoxy resin, a curing agent, and at least one toughening agent comprising an epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage. The polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000, an average functionality of at least about 2.2, and the functionality of the polyacrylate from which the epoxy-extended polyacrylate is derived is a carboxylic acid. Optionally, the composition includes a filler.

Wang describes polymers with structures and molecular weights different to those defined herein. The epoxy-extended polyacrylates used to improve fracture toughness in epoxy-based adhesive compositions of the

present invention have epoxy end groups linked to a polyacrylate fragment through a  $\beta$ -hydroxyester linkage formed in the polyesterification step. See e.g. specification, page 5, paragraph [0021] and Example 1. In contrast, the polymers described in Wang have epoxy functional groups linked to the polyacrylate fragments through a hydrocarbon linkage. The  $\beta$ -hydroxyester linkage found in the epoxy-extended polyacrylates used in the practice of the present invention adds polarity to the polymer. This added polarity is beneficial in promoting adhesion of the toughening agent to a filler, if used, and to the substrate surfaces. The added polarity also improves compatibility between the toughening agent and uncured epoxy monomers with which the toughening agent is intended to be used.

This latter point distinguishes from the use to which Fock intends to place his materials. That is, Fock's material is for use as a flexibilizer, which will render the product with which the flexibilizer is to be used to be more peel resistant. In contrast, the toughening agents of the present invention improve fracture toughness in epoxy-based compositions, which may or may not affect the peel

resistance. However, Fock's material would not improve fracture toughness.

In addition, the molecular weights of Wang's polymers are in the range of 26,000-40,000 -- that is over 2.5 times (and up to 4 times) that of the epoxy-extended polyacrylates used herein, which by the definition of the two independent claims are in the range of about 1000 up to about 10,000.

Fock is directed to and claims a method for flexibilizing epoxide resins comprising adding to the epoxide resins prior to curing, copolymers obtained by the polymerization of A<sub>1</sub>) 40 to 87 weight percent of one or more alkyl esters of acrylic or methacrylic acid having 1 to 8 carbon atoms in the alkyl radical, A<sub>2</sub>) 10 to 40 weight percent of vinyl acetate or acrylonitrile, A<sub>3</sub>) 1 to 20 weight percent of acrylic, methacrylic or itaconic acid, A<sub>4</sub>) 1 to 5 weight percent of glycidyl acrylate or glycidyl methacrylate, and A<sub>5</sub>) 0 to 35 weight percent of acrylic or vinyl monomers which are different from the monomers A<sub>1</sub> to A<sub>4</sub>, in the presence of a regulator, which contains mercapto groups and has at least one carboxyl group, where the copolymers having an average molecular weight of 1,000 to 3,000, as measured in a vapor pressure osometer, in amounts

such that 1 to 60 mole percent of the epoxide groups of the epoxide resins react with the carboxyl groups of the copolymer.

As can be seen from the manner by which the epoxy-extended polyacrylates used herein are made, these materials are not the copolymers described by Fock. More specifically, Fock requires a copolymer made from alkyl esters of acrylic or methacrylic acid, vinyl acetate or acrylonitrile, glycidyl acrylate or glycidyl methacrylate, and acrylic or vinyl monomers. Applicants' epoxy-extended polyacrylates are not so defined.

Fock as noted above is directed to flexibilizing, which often does not correlate with toughness. Peel strength increases with increased flexibility; fracture toughness does not necessarily improve. Rather, just the opposite is ordinarily observed. A more flexible material is often softer, which tends not to provide improved toughness.

Thus, Fock is directed to a different end use altogether, let alone that which is recited in independent Claim 19 -- that is, a method of improving fracture toughness.

It is well settled that in order to be an effective anticipatory reference, a single document must disclose each and every recitation of a claim under review. Failing such precise disclosure, rejections under Section 102 are improper. Here, neither Wang nor Fock possesses such disclosure.

For instance, neither Wang nor Fock speaks to improving fracture toughness or to an epoxy-extended polyacrylate having at least one  $\beta$ -hydroxyester linkage.

Therefore, as neither Wang nor Fock discloses each and every recitation of the claims under review, the Section 102(b) rejections based thereon cannot stand and as such Applicants request reconsideration and withdrawal thereof.

As regards the Section 103 rejection over each of Wang and Fock, epoxy-based adhesive compositions containing either Wang's or Fock's polymers are unlikely to have adequate capillary flow for microelectronic assembly applications, such as underfill applications. This is so because the polyacrylate from which the epoxy-extended polyacrylate is derived has a number average molecular weight in the range of about 1000 up to about 10,000 and an average functionality of at least about 2.2. The molecular

weight ranges are discussed and contrasted above. The average functionality confers branching to the polyacrylate. The branching translates into a lower viscosity, which means that the polyacrylate is more dispensable or flowable. Neither Wang nor Fock discloses, teaches or suggests epoxy-extended polyacrylates having such requirements.

To conclude that the pending claims are obvious over either Wang or Fock as the Examiner has, could only have come about from the use of impermissible hindsight. That is, the Examiner must have used the subject application as a basis for filling in the gaps of the two cited documents of record. Hindsight as the Examiner knows can find no place in the examination of applications for Letters Patent.

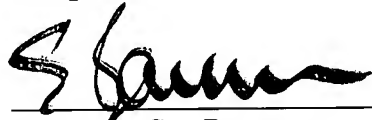
Based on the above, Applicants submit the application is in condition for allowance.



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Respectfully submitted,

A handwritten signature in black ink, appearing to read 'S. Bauman', written over a horizontal line.

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